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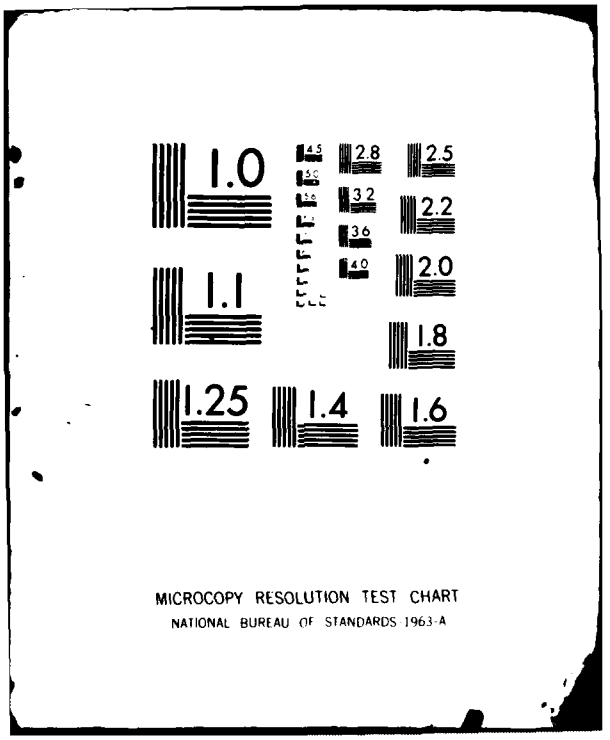
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OFFICE OF NAVAL RESEARCH

4TH INTERNATIONAL TOPICAL CONFERENCE ON HIGH-POWER ELECTRON AND ION-BEAM RESEARCH AND TECHNOLOGY

JOHN R. NEIGHBOURS

9 OCTOBER 1981

BRANCH OFFICE
LONDON
ENGLAND

UNITED STATES OF AMERICA

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The Fourth International Topical Conference on High-Power Electron and Ion-Beam Research and Technology was held in Palaiseau, France on 29 June - 3 July 1981. The program included electron and ion beam generators, beam transport plasma heating and free electron lasers. This report is principally about foreign research results. It also contains a list of speakers and the topics discussed.

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4TH INTERNATIONAL TOPICAL CONFERENCE ON HIGH-POWER ELECTRON AND ION-BEAM RESEARCH AND TECHNOLOGY

The Fourth International Topical Conference on High-Power Electron and Ion Beam Research and Technology was held in France on 29 June - 3 July 1981. The 5-day program included discussion on high-power electron and ion-beam generators, focusing and deposition of energy, applications to inertial confinement fusion (ICF), plasma heating, generation of mm waves; and free electron lasers. It brought together at least two different research communities. The official language of the conference was English. A list of oral sessions is included in Appendix I.

Organized by the Commissariat à l'Energie Atomique and the Ecole Polytechnique, the conference was under the direction of Prof. H.J. Doucet of the Ecole Polytechnique and was held at that modern institution, which has been located near the town of Palaiseau, approximately 20 km southwest of Paris, since 1976. Buses were used to transport the participants to the Ecole Polytechnique - an arrangement that made for rather long days (8 a.m. to 6:30 p.m.) but had the advantage of keeping everyone together.

Those who attended the conference were furnished abstracts of both the oral and poster sessions. Those persons presenting papers were urged to turn in a camera-ready copy at the meeting. The published proceedings are expected to be available in a few months from the local chairman, Prof. Doucet, whose address is listed in Appendix II. Since US research is expected to be familiar to US workers, this report concentrates on the results of research in other countries.

The US, with 85 representatives, and France, with 83, accounted for 73 percent of the 230 attendees from 13 countries. Other countries sending participants were: FRG (14), USSR (14), Japan (10), Switzerland (6), Israel (6), UK (5), the Netherlands (3), and Australia, Poland, Czechoslovakia, and East Germany, one each. As indicators of research activity these figures are somewhat misleading, because, as was to be expected, the host country (France) had a larger than ordinary attendance. A better indicator is the list of oral sessions (see Appendix I), from which it is evident that about two-thirds of the papers presented were from the US. Many, if not all, of the papers presented the results of large-scale research projects involving many persons. As a result, the meeting was somewhat unusual in that the number of authors (476) was more than twice the number of participants.

The format of the conference was two oral sessions each morning and afternoon separated by a poster session at which coffee was available. All the oral sessions were single ones. The presentations varied between 20 and 25 min. Most papers, including discussion, took about 20 min; the session chairman generally acted to maintain the schedule. Except for considerable shifting and cancellation of papers, principally by USSR scientists, the oral sessions generally were adequate to good; the presentations by US scientists, in general, were exceptionally good.

A large fraction of the posters were cancelled and in addition, even though the conference instructions warned against the practice, many poster papers were just that—merely posted, with no one to discuss the work. In the poster-session area, room also was available each day for the poster

presentation of papers that had been presented that day as oral ones. Although the presentations often consisted merely of copies of viewgraphs, the scheme was more satisfactory to the author and presumably to others since the area surrounding the poster papers was often quite crowded.

Progress in research on light ion beams for inertial confinement fusion (LIB for ICF) was discussed by representatives from Sandia National Laboratory, the Naval Research Laboratory, and by several representatives of the newer Japanese effort. The program at Osaka was presented by Dr. S. Higaki (Inst. of Laser Engineering, Osaka Univ.) who directs it. Higaki's approach to light-ion ICF is similar to that developed at NRL. The latter utilizes many pulsed-power modules with individual ion-diode loads. Each diode focuses the beam through plasma into the entrance of a Z-pinch transport channel a few meters long so that each beam is bunched during transport. The beams exit the channels and irradiate the pellet from all sides.

Higaki told of developments using REIDEN IV, a possible module for a megajoule driver system for a fusion device. This machine, consisting of a 2.5-MV, 150-kJ Marx generator, an intermediate storage capacitor, a coaxial pulse-forming line, and a tapered transmission line, is presently operating near the 1 TW level. It is the largest machine outside the US dedicated to light ions and is part of an effort to study pulse-power technology and focused-beam generation. With a pinch-reflex ion diode connected to the line output, a proton current of 300 kA at 0.8 MV was obtained. The diode had a current density of approximately 1.3 kA/cm^2 with a pulse that terminated in 120 ns.

Beam diagnostics and focusing were performed by several methods (biased charge collectors, mass spectrometer, nuclear activation analysis, neutron yield, x-ray pinhole camera and shadow box) with the energy determined from the yield ratio of boron nitride activation agreeing with that determined from the bias charge collector measurements. Best focus of the ion beam was in a 2-cm-diameter circle with an anode plasma temperature of $\sim$ 10 ev estimated from the charge state of the carbon atoms in the beam. When focused on a solid target, the beam power density was estimated to be $\sim 10^{10}$ W/cm^2 with higher efficiency of deposition than that resulting from laser irradiation. According to Higaki, the transport of a focused beam is a critical problem in the design and construction of a reactor of this type.

Dr. K. Yatsui (Laboratory of Beam-Fusion Technology, Technical Univ. of Nagaoka, Nagaoka, Japan) spoke about the research at Nagaoka on LIB for ICF, which is termed the ETIGO Project. In a preliminary experiment at about half of full power, this research group has produced an ion-beam current of $\sim$ 14 kA by use of a spherically shaped, magnetically insulated diode. (The purpose of this type of diode is to provide a magnetic field transverse to the accelerating gap which is strong enough to turn the electrons drawn off the cathode by field emission while allowing the more massive ions to cross the gap.) At the focus, the maximum current density of the LIB was $\sim$ 4 kA/cm^2. The beam was guided to the target by a pinched channel of approximately 1-kG maximum magnetic field produced by an exploding wire. To date, about 2,000 shots have been fired at a maximum rate of 40 per day.

Dr. K. Niu (Tokyo Inst. of Technology, Yokohama) reported on a LIF reactor-system study based on the multibeam-transport concept. He examined requirements for 10 to 100 MW electrical-output powers using 100 TW proton beams of various pulse durations and energies. Such a calculation requires many simplifying assumptions that gloss over current physics problem areas. However, the work represents the first effort to include many effects such as beam generation, beam handling, pellet physics, and reactor energetics in a single model.

Ion production was the subject of two sessions in which US research was discussed by Dr. C.W. Mendel (Sandia National Laboratories), Dr. G. Cooperstein (Naval Research Laboratory) and Dr. D.A. Hammer (Cornell Univ.). Other countries represented were France and the USSR (one USSR paper was not presented). Dr. N. Camarcat (Centre d'Etudes de Valduc) noted that the French were new in this field and presented the results of the experiments on LIB production with two low-impedance accelerators. Dr. A. Bernard (Centre d'Etudes de Limeil) discussed the generation of LIB in a 340-kJ plasma focus. A fast annular valve with 48 orifices ejected puffs of gas that were broken down into electrons and ions by the discharge from a large capacitor bank. The apparatus is provided with a vacuum lock so that both the cathode and anode may be changed rapidly. The French results are preliminary, but they support the scaling laws for diode impedance and ion production observed in NRL research.

Dr. D.D. Ryutov (Inst. of Nuclear Physics, Novosibirsk, USSR) spoke about the "gas-dynamic" method of obtaining a high-current ion beam, which, he emphasized, is not the main line of investigation at the institute. Acceleration of ions in this scheme occurs from the electric field of a cloud of oscillating electrons. The name of the scheme is derived from the similarity between the gas dynamic equations and those describing expansion into a vacuum of a cloud of oscillating electrons neutralized by the accelerating ions. The first experiments were conducted with a 20-kA machine; later, two devices of 150 and 250 kA were constructed. Ryutov and his coworkers have found that the maximum ion energy can be increased by using an inhomogeneous guiding magnetic field through the dense neutralizing plasma. The efficiency of acceleration of hydrogen ions is 50 percent, decreasing to between 30 and 40 percent for ions with a mass number of 40.

The transport of beams was also the subject of two sessions. Dr. S. Goldstein (Naval Research Laboratory), Dr. J.R. Freeman (Sandia National Laboratories), Dr. F.L. Sandel (Jaycor), Dr. M. Lampe (Naval Research Laboratory), Dr. F.J. Sazma (Naval Surface Weapons Center), and Dr. A.E. Blaugrund (Naval Research Laboratory) each discussed an aspect of the US research in this field. Dr. N. Metzler (Max-Planck-Institut für Quantenoptik, Garching) presented results of calculations on the shift of focus of heavy ion beams as a result of magnetic fields. Space charge neutrality, ionization of the plasma both by beam energy deposition and by ionizing collisions, and negligible hydrodynamic motion of the plasma during the passage of the ion beam were assumed. Calculations were of axially symametric paraxial rays, and, for a particular case of exponential buildup of beam current to a constant value, gave a shift (diminution) of focus of $\sim$ 23 cm. As the radius of the beam decreases, the temperature of the plasma increases, an effect thought to produce a high conductivity.

Further calculations on the best focus case showed that it is stable against various perturbations. In addition, the conductivity was artificially changed by a factor of 10, causing the beam focus to become greater by 33 cm, which was in agreement with the above-mentioned conjecture that high conductivity is associated with the shortening of focal distance.

P.H. deHaan (FOM Inst. for Atomic and Molecular Physics, Amsterdam) gave details of propagation experiments of a relativistic electron beam (850 keV, 6 kA, 150 ns) injected into a long (2.5m) drift space, filled to different pressures with hydrogen gas. At a pressure of $\sim$ 1 Torr, propagation is quite good with a mean beam energy loss of 2.5 percent per meter. The dominant plasma ion is H_3^+, but H^+ and H_2^+ are also present and the results of measurements are in good agreement with computational ones.

The results of a computer simulation of an intensely relativistic electron beam passing through an initially neutral low-pressure gas were presented by Dr. W. Hintze (Zentralinstitut für Electronenphysik, Berlin, DDR) who said that the motivation for the work was to investigate deep potential well acceleration, to explain the increased ion energy observed, to understand the beam-plasma interaction behind the beamfront, and to provide a simple code that could be used for parametric studies. Using a 1-dimensional model, Hintze calculated electron and ion densities and velocities as well as the potential. Ionization of ions was neglected, and secondary electrons could be neglected or not, depending on the strength of the assumed longitudinal magnetic field. The beam front was found to move with a characteristic velocity with a plasma formed behind the beam front. Some ions acquired up to a factor of 4 times the beam energy. Varying the longitudinal-magnetic field and the initial density of particles only gave changes in scale. Doubling the length of the drift space had no effect. There was no deep potential-well acceleration, but an instability in the injected beam appeared behind the beamfront.

Progress in the development of a pulsed e-beam system for a high-power KrF laser was discussed by Dr. F. O'Neill (Rutherford and Appleton Laboratories, Dicot, England), who noted that he began this project after some experiments on illuminating 100-μm diameter spherical targets with a frequency-doubled green laser. Excitation will be transverse and will be achieved by means of four 500 KV, 5-Ω diodes arranged in an x configuration with the diodes at the corners and the gas in the center. The volume of gas to be pumped will be contained in a 25-cm-diameter x 100-cm-long cylinder ($\sim$ 49 l). A large-area test diode half the size of that to be fitted to the laser has been constructed; after several cathode types were tested, a multipointed design was adopted. Triggering will be achieved by means of a laser-activated spark gap. One of the four required pulse forming lines and spark gaps has been built and successfully tested at full charge voltage. The group is now starting to assemble the components of the laser.

The sessions on free-electron lasers were indicative that there were still relatively few experimental results. However, Dr. H. Boehmer (TRW, Redondo Beach, CA.) discussed an amplifier experiment in the single-particle regime where the efficiency of production of 10-μm radiation was enhanced by means of a tapered wiggler. The device, which was constructed

from small SmCo permanent magnets h[illegible]d fixed in a frame, had a central section containing 75 spatial periods of 3.56 cm (L = 267 cm) and end sections 30 cm long in which the spatial period (the taper) varied along the length. The measured small-signal gain of the system was determined to depend on the taper.

Dr. V. Granatstein (Naval Research Laboratory) also discussed experimental results. He noted the effects of recent improvements in beam quality on the VEBA accelerator. (The paper was to have been given by Dr. R.K. Parker, who became ill at the meeting.) To measure the spread of the perpendicular component of the electron velocities, the NRL group passed the beam through a pipe in a variable magnetic field. As the field was lowered, the Larmor radius increased, and the electrons with the largest velocity component struck the wall and were lost first. When the system using a periodic (3 cm) transverse magnetic field was operated as an amplifier, the output of electromagnetic radiation at 3.5 μm was in agreement with calculations.

Collective free electron laser experiments were also described by L. Vallier (Ecole Polytechnique, Palaiseau, France), who said that in the French work, an axial guiding field was used along with a wiggler magnet consisting of a double helix with a 2-cm pitch. The experiments were with a 5-kA, 1-MeV, 20-ns duration electron beam passing through the wiggler magnet. Output radiation was analysed with a 50 to 350 GHz grating spectrometer and was found to be zero for zero pump field. Radiation was observed for small pump fields (100 gauss) and was perceived to be broad band, covering the range of the spectrometer. Although resonance conditions occur when the electrons move one period of the wiggler field during one cyclotron orbit, no narrow-band signal was observed. Radiation was only observed when the resonant condition was fulfilled, but the radiation was broad band.

The final session was not a panel discussion as advertised. Rather, it was a series of speeches with each speaker giving his summary of the meeting. Prof. D.D. Ryutov (Inst. of Nuclear Physics, Novosibirsk, USSR) said that although many persons felt disappointed at the apparent lack of progress, there had, indeed, been progress. Machine currents had increased from 100 kA to 8 MA in the last 10 years, the Amfion diode was new, and plasma heating in solenoids sounded interesting. In addition, Ryutov noted that, although no new ideas relating to Tokamaks had been forthcoming since the 1960s, people did work on these machines and found the work interesting.

Dr. G. Yonas (Sandia National Laboratories, Albuquerque, NM) noted that technology provides new opportunities for progress in physics. Pulse-power technology is important in learning about large machines, which at present should have considerable flexibility. This new flexibility, in which the large investments that have been made ($\sim \$200 \times 10^6$) can be reconfigured (high impedance, low impedance, etc.), is an important instance of progress in technology.

Other significant advances are represented by the progress that has been made in developing magnetic insulation and ballistic ion-beam focusing, which are important in obtaining fusion. On the subject of fusion, the most important task is to demonstrate ignition, and efforts should be concentrated on that task with less emphasis on reactors and power systems.

Until recently, the field of handling ion beams was relatively empirical. Now, theorists are working actively in this area, and Yonas regards the expressions of gloom and doom as healthy—it means the problems are under attack.

As did the other panelists, Dr. R. Dautray (chairman of the Organizing Committee) welcomed the participation, for the first time, of German and Japanese groups; he also said that he expects to see new projects announced for 1983. Dautray was of the opinion that studies of beam divergence and a code to explain diode behavior were needed, and that the development of free-electron lasers should prove beneficial through the development of large current devices such as the induction accelerator. He also expressed the belief that the relativistic magnetron and gyrotron have interesting futures in the microwave field. Dautray concluded by thanking the participants for attending and leading a round of applause for Prof. Doucet.

Attendance at this long conference with successive lengthy sessions required considerable endurance. Nevertheless, those with whom this author spoke universally agreed that the advantage of bringing together experts from several fields and many countries outweighed the discomforts. Much information was presented, and the next meeting, scheduled to be held in San Francisco in 1983, will probably have more results presented by non-US researchers. The local chairman for the next meeting is Dr. R.J. Briggs, whose address appears in Appendix II and from whom information about the next conference can be obtained.

APPENDIX I

ORAL SESSION PROGRAM

The papers presented had from 1 to 15 authors with a peak in the distribution at 4. In this compilation, for most papers with more than 2 authors, only the person who presented the paper is listed.

Monday 29 June

LIGHT ION BEAMS FOR INERTIAL CONFINEMENT FUSION I

"Scalability of Light Ion Beams to Reach Fusion Ignition"
G.W. Kuswa et al.
Sandia National Laboratories, Albuquerque, NM

"Research at the Institute of Laser Engineering on Inertial Confinement Fusion by Light Ion Beams"
S. Higaki et al.
Institute of Laser Engineering, Osaka University, Japan

LIGHT ION BEAMS FOR INERTIAL CONFINEMENT FUSION II

"System Requirements for Light-Ion Inertial Confinement Fusion"
D. Mosher et al.
Naval Research Laboratory, Washington, DC

"Intense Light-Ion Beam Generation, Focusing, Propagation, and Target Irradiation"
K. Yatsui et al.
Laboratory of Beam Fusion Technology, The Technological University of Nagaoka, Nagaoka, Niigata, Japan

"Analysis of Inertial Confinement Fusion Using a Light-Ion Beam"
K. Niu et al.
Department of Energy Sciences, Tokyo Institute of Technology
Midori-Ku, Yokohama, Japan

ION PRODUCTION I

"Theory of Ampfion Class Ion Diodes"
C.W. Mendel et al.
Sandia National Laboratories, Albuquerque, NM

"Light Ion Production and Focusing With Pinch-Reflex Diodes"
G. Cooperstein et al.
Naval Research Laboratory, Washington, DC

"Light Ion Beam Production on Low Impedance Generators"
N. Camarcat et al.
C.E.A.-D.A.M.-S.E.C.R. Centre d'Etudes de Valduc, France

"Proton and Deuteron Beam Acceleration on the Thalie Generator"
J. Cortella et al.
C.E.A.-D.A.M.-S.E.C.R. Centre d'Etudes de Valduc, France

ION PRODUCTION II

"The Work on High-Current Ion Beams at Novosibirsk Institute of Nuclear Physics"
D.D. Ryutov
Institute of Nuclear Physics, Novosibirsk, USSR

"Intense Ion Beam Source Development Experiments"
D.A. Hammer et al.
Laboratory of Plasma Studies, Cornell Univ., Ithaca, NY

"Generation of Particle Beams in a 340 kJ Plasma Focus With Gas Injection by Fast Valve"
A. Bernard et al.
Commissariat à l'Energie Atomique, Centre d'Etudes de Limeil, France

Tuesday 30 June

BEAM TRANSPORT I

"Intense Ion Beam Handling in Preformed Magnetized Plasmas"
S.A. Goldstein et al.
Naval Research Laboratory and Jaycor, Inc., Washington, DC

"Plasma Channels For Intense Ion Beam Transport-Theory"
J.R. Freeman et al.
Sandia National Laboratories, Albuquerque, NM

"Experimental Studies of Intense Light-Ion Beam Transport"
F.L. Sandel et al.
Jaycor, Inc. and Naval Research Laboratory, Washington, DC

"Propagation of Intense Charge-Neutral Ion Beams in Magnetic Fields"
S. Robertson et al.
University of California, Irvine, CA

"Analytic and Numerical Studies of the Resistive Hose Instability"
M. Lampe et al.
Naval Research Laboratory, Jaycor and Naval Surface Weapons Center, Washington, DC

IMPLODING PLASMA LOADS I

"Dynamics and Stability of Imploding Plasmas"
G. Dahlbacka et al.
Physics International Co., San Leandro, CA

"Diode Insulation With Radiating Plasma Loads"
A. Wilson and M. Friedman
Systems, Science and Software Co.
P. O. Box 1620
La Jolla, CA 92038

"Laser Plasma Pinching in a High-Current Accelerator Diode"
A.A. Kolomensky et al.
P. N. Lebedev Physical Institute, Moscow, USSR

IMPLODING PLASMA LOADS II

"Imploding Plasma Loads For High Power Pulsed Generators"
J. Pearlman et al.
Maxwell Laboratories Inc., San Diego, CA

"Dense, High Temperature Plasmas Generated By Imploding Wire Arrays"
W. Clark et al.
Maxwell Laboratories, San Diego, CA

BEAM TRANSPORT II

"Filamentation Instability in Heavy Ion Beams"
N. Metzler, K. Brueckner, and R. Janda,
Max-Planck Institut für Quantenoptik, Garching, FRG.

"Injection and Propagation of Multiple Relativistic Electron Beams
Using Wire Driven Plasma Channels"
F.J. Sazama and V.L. Kenyon III,
Naval Surface Weapons Center, White Oak, MD

"Transport Properties of a Relativistic Electron Beam Injected Into Gas"
H.J. Hopman et al.
FOM Institute for Atomic and Molecular Physics, Amsterdam, The Netherlands

"Development of Pulsed E-Beam Systems For Large Volume, High Power KrF Lasers"
F. O'Neill et al.
Rutherford and Appleton Laboratories, Chilton, England

"A Time Resolved Beam Profile Monitor For Intense Ion Beams"
A.E. Blaugrund et al.
Naval Research Laboratory, Washington, DC

Wednesday 1 July

DIODE PHYSICS

"Electromagnetic and Quasi-Static Simulations of Ion Diodes"
A.T. Drobot et al.
Science Applications Inc., Jaycor and Naval Research Laboratory,
Washington, DC

"Virtual Cathode Formation in Electron Beams as a Bifurcation Phenomenon"
D.J. Sullivan and E.A. Coutsias,
University of New Mexico, Albuquerque, NM

"Forced Self-Magnetic Insulation of a B-Theta Diode"
K.W. Zieher,
Institut für Kernphysik, Karlsruhe, FRG

"Dynamics of Electron Sheaths in Magnetically Insulated Diodes"
R.N. Sudan,
Laboratory of Plasma Studies, Cornell University, Ithaca, NY

"Study of Cathode Plasma Expansion in High-Current Magnetically Insulated Diodes"
S.P. Bougaev et al.,
High-Current Electronics Institute, Tomsk, USSR

ENERGY DEPOSITION

"Kα Diagnostics For Particle Beam Target Interaction"
E. Nardi and Z. Zinamon,
Weizman Institute, Rehovot, Israel

"Slowing Down of Heavy Ions In a Ionized Metal Target. Relevance to The Heavy Ion Inertial Fusion and Experimental Study Proposal"
R. Dei-Cas,
Centre d'Etudes de Bruyères-le-Chatel, Montrouge, France

"Energy Involved in Pinched Relativistic Electron Beam Plasma Interaction Experiments"
R. Bailly-Salins et al.
Centre d'Etudes de Valduc, France

"Energy Deposition of Relativistic Electron Beam in Thin Polyethylene Foils"
M. Gazaix et al.
Ecole Polytechnique, Palaiseau, France

PLASMA HEATING AND MAGNETIC CONFINEMENT

"Application of Intense Pulsed Ion Beams To Magnetically Confined Fusion"
K.O. Busby et al.,
Laboratory of Plasma Studies, Cornell Univ., Ithaca, NY

"Heating of Dense Plasmas Via an Intense Relativistic Electron Beam: Initial Observations"
M.D. Montgomery et al.,
Institute of Nuclear Physics, Novosibirsk, USSR

"Plasma Heating in Solenoids by High-Current Electron Beams"
V.S. Koidan et al.,
Institute of Nuclear Physics, Novosibirsk, USSR

HEAVY IONS

"The Heavy Ion Fusion Program at Argonne"
J.M. Watson and R.L. Martin,
Argonne National Laboratory, Argonne, IL

"The Influence of Target Requirements on the Production, Acceleration, Transport and Focusing of Ion Beams"
R.O. Bangerter et al.
Lawrence Livermore Laboratory, Livermore, CA

"Driver-Reactor Interface For Heavy Ion Fusion"
M.D. Nahemow,
Westinghouse Research and Development Center, Pittsburgh, PA

"Numerical Studies of the Generation of Gev Heavy Ions at Laser Irradiation"
H. Hora et al.
University of New South Wales, Sydney, Australia

Thursday 2 July

COLLECTIVE ION ACCELERATION

"Collective Ion Acceleration Studies At The University Of Maryland"
W.W. Destler et al.
University of Maryland, College Park, MD

"Proton Collective Accelerator Studies"
J.A. Nation et al.
Laboratory of Plasma Studies, Cornell University, Ithaca, NY

"Studies of The Collective Focusing Ion Accelerator"
A. Fisher et al.
University of California, Irvine, CA

"One Dimensional Simulation of Collective Ion Acceleration by An Intense Relativistic Electron Beam Moving Through Low Pressure Gas"
W. Hintze,
Zentralinstitut für Elektronenphysik, Berlin, DDR

"Development of Collective Acceleration Method At Joint Institute For Nuclear Research"
V.P. Sarantsev and I.N. Ivanov,
Institute For Nuclear Research

HIGH POWER TECHNOLOGY

"PBFA-I: Pulsed Power Driver For Inertial Confinement Fusion"
J.P. Vandevender et al.
Sandia National Laboratories, Albuquerque, NM

"Pulsed Power Research On Eagle"
G.B. Frazier et al.
Physics International, San Leandro, CA

"Multi-Megajoule Inductive Storage For Particle Beam Production and Plasma Implosions"
I.M. Vitkovitsky et al.
Naval Research Laboratory, Washington, DC

FREE ELECTRON LASERS I

"Experiment and Theory of Free Electron Laser Efficiency Enhancement With A Variable Wiggler"
H. Boehmer et al.
TRW, Inc. Redondo Beach, CA

"Two-Dimensional Theory and Simulation of Free Electron Lasers"
T.J.T. Swan and J.R. Cary,
Los Alamos National Laboratory, Los Alamos, NM

"Theoretical Investigation of a 10-μm Free Electron Laser Amplifier Using A 50-MeV Multi kA Electron Beam"
V.K. Neil and D. Prosnitz,
Lawrence Livermore Laboratory, Livermore, CA

ACCELERATORS

"High-Current Betatron"
N. Rostoker et al.
University of California, Irvine, CA

"Injection Into A Modified Betatron Electron Accelerator"
P. Sprangle et al.
Naval Research Laboratory, Washington, DC

"Physics Of A Repetitively Pulsed 10 kA Electron Beam Accelerator"
T.J. Fessenden et al.
Lawrence Livermore Laboratory, Livermore, CA

"Beam Tests On The 4-kA, 1.5-MeV Injector For FXR"
B. Kulke et al.
Lawrence Livermore Laboratory, Livermore, CA

Friday 3 July

MICROWAVES

"Non Linear Analysis Of The Quasi-Optical Electron Cyclotron Maser"
J.L. Vomvoridis et al.
Naval Research Laboratory, Washington, DC

"Investigation On Powerful Microwave Generation In Relativistic Magnetrons"
A.A. Kolomensky et al.
P.N. Lebedev Physical Institute, Moscow, USSR

"The Relativistic Electron Beam Pulse-Periodic Microwave Generators"
G.A. Mesyats et al.
High-Current Electronics Institute, Tomsk, USSR

"Study Of Relativistic Electron Beam Generator Output Energy Concentration"
Golovin, et al.

FREE ELECTRON LASERS II

"A Superradiant Raman Free Electron Laser Experiment"
V.L. Granatstein et al.
Naval Research Laboratory, Washington, DC

"Collective Free Electron Laser In Resonant Pump Conditions: Experiments And Theory"
L. Vallier et al.
Ecole Polytechnique, Palaiseau, France

"Theory Of Relativistic Cyclotron Resonance Masers"
G.S. Nusinovitch et al.
Institute of Applied Physics, Gorky, USSR

FINAL SESSION

"Comments On ANGARA V Program"
L.I. Rudakov

Panel Discussion
G. Yonas, Sandia National Laboratory, Albuquerque, NM
D.D. Ryutov, Institute Of Nuclear Physics, Novoskbirsk, USSR
R. Dautray, CNRS, France

APPENDIX II

MEETING LOCAL CHAIRMEN

4th International Conference (29 June - 3 July, 1981), Palaiseau, France

Prof. H. J. Doucet
Laboratory PMI
Ecole Polytechnique
91128 Palaiseau Cedex
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5th International Conference (1983), San Francisco, CA

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8